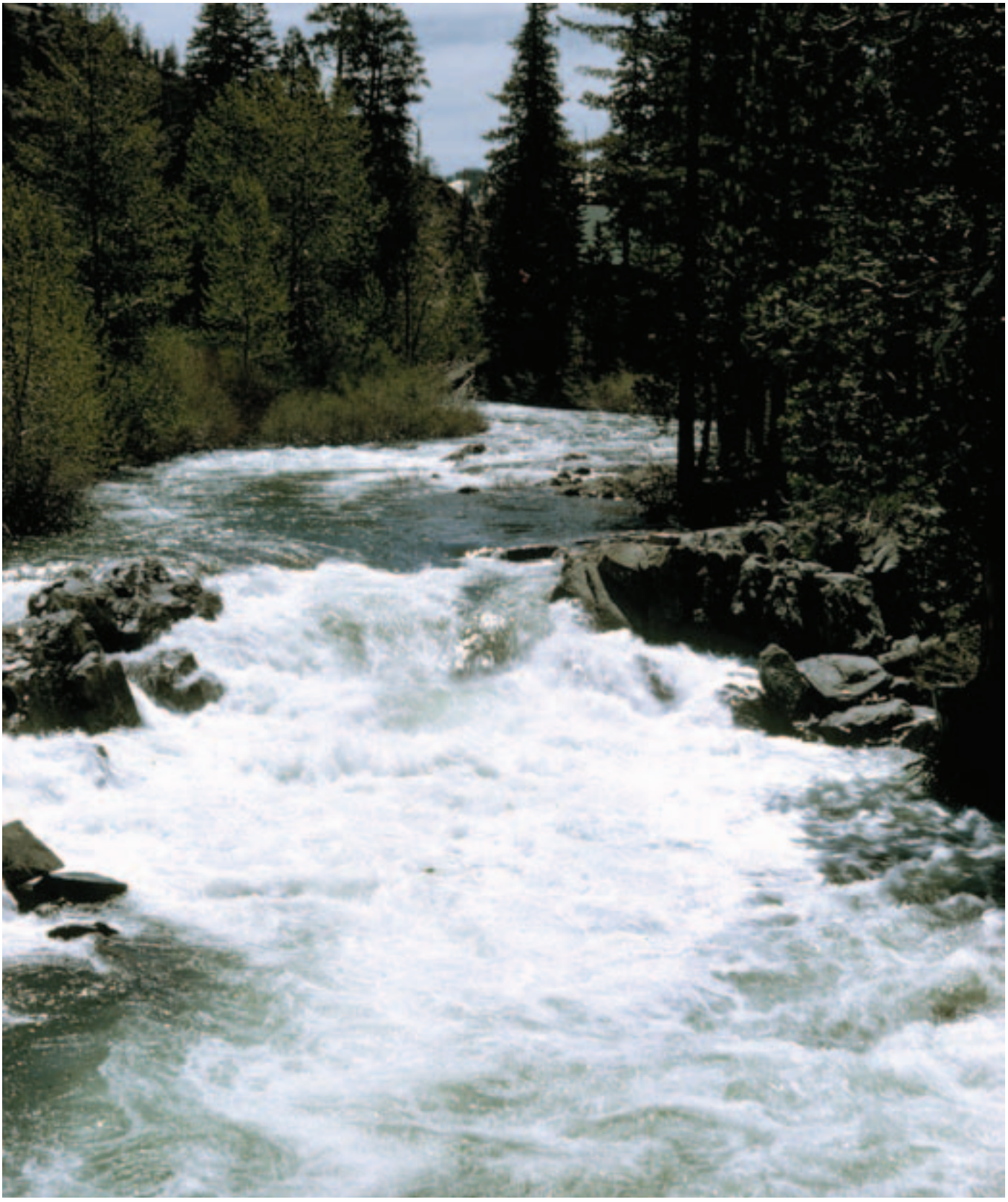
Volume 2

Chapter 25 Watershed Management



Watershed management integrates human needs and ecological condition to allow the watershed to sustain ecological integrity over time while providing sustainable community needs. (DWR photo)

Chapter 25 *Watershed Management*

Watershed management is the process of evaluating, planning, managing, restoring, and organizing land and other resource use within an area of land that has a single common drainage point. Watershed management tries to provide sustainable human benefits, while maintaining a sustainable ecosystem. Watershed management assumes that a prerequisite for any project is the sustained ability for the watershed to maintain the functions and processes that support the native ecology of the watershed. This does not imply that a goal is to return the watershed to an undisturbed condition. Instead it implies an integration of human needs and ecological condition that allows the watershed to sustain ecological integrity over time while providing for sustainable community needs. It is recognized that watersheds are dynamic and the precise makeup of plants, animals, and other characteristics will change over time. Watershed management seeks to balance changes in community needs with these evolving ecological conditions.

Watersheds offer a convenient scale for considering how factors can degrade or enhance resource conditions (See Box 25-1). Watersheds collect all of California's precipitation, rain, snow, and fog; filter or treat much of it; store more water than all of the state's reservoirs combined; and release water to rivers and groundwater at rates that vary with watersheds. Managing our watersheds can be thought of as the necessary maintenance of our natural infrastructure.

The natural processes that make watersheds valuable to the state are susceptible to damage and degradation. That damage threatens to significantly impact and reduce the ability of those watersheds to function and provide those benefits that the state depends upon. This is evident through reductions in water infiltration, degradation of water quality, increased maintenance costs from erosion related impacts, changes in runoff patterns and timing, decreased ability of mountain meadows to capture and hold snowmelt for later natural accretion into streams, and decreased populations of native flora and fauna. These factors threaten the state's economy that is directly, and indirectly, dependent on the condition and trend of its watersheds.

Underpinning watershed management is the need to understand ecological processes important to the local watershed. One approach to understanding these processes is to describe various ecological cycles and watershed traits, such as the hydrologic cycle, nutrient cycling, energy flow and transfers, soil and geologic characteristics, the role of fire, and animal migration and habitat utilization (See Box 25-2). Understanding these watershed processes allows for adaptively managing the watershed. In some cases the description of these processes will highlight that some infrastructure, programs, or projects are not sensitive to watershed processes. In these cases reoperation or redesign the infrastructure, programs, or projects may greatly improve their compatibility with the watershed processes.

Box 25-1 What is a Watershed?

In its simplest context a watershed is an area of land with a single common drainage point. In the context emerging for planning purposes in California, a watershed includes living (including the people who live and work in the watershed) and non-living elements within a defined geographical area that is generally characterized by the flow of water. The flow of water defining a watershed includes both surface water and groundwater as it moves through natural and manmade features, from higher elevations to lower elevations. Throughout the state we have engineered the flow of water such that defining watershed boundaries is often prefaced on hydrologic features but adjusted to accommodate water conveyance systems. In some cases planning watershed boundaries may be influenced by administrative boundaries as well, such as city limits.

Watershed Management in California

Groups pursuing watershed management are now operating in all regions of California. It is estimated that several hundred watershed stewardship groups are now active in the state. A recent request of watershed management grant proposals produced more than 330 applications from all parts of the state. Proposals included both local and regional projects. Local projects addressed support for local stewardship groups, watershed assessment, and planning and project implementation. Regional proposals centered on creating and coordinating networks for local watershed groups. From strictly private land holdings to consortia of public and private interests, people are focusing on the watershed scale as a way to create understandable and meaningful resource management efforts that provide multiple benefits and are designed to achieve sustainable ecosystems (See Box 25-3).

Box 25-2 Issues Facing California Watersheds That Affect Water

Land uses alter hydrologic cycles – The hydrologic cycle includes snow or rain, the flow of water over and beneath the land, and the evaporation of water into the atmosphere. How the land is managed can reduce rainwater infiltration and the timing, and in some case, the volume of stormwater runoff. Storms, especially in urban areas, but also in some rural areas are now marked by high intensity runoff over short periods. This creates greater flood risk and reduces the ability to capture water for needs during dry times. From an ecological perspective, this compression of runoff events robs the streams and landscape of groundwater. This leads to dry land, a shift in vegetation types, lower and warmer streams, deterioration of stream channels, all of which lead to shifts in the plants and animals that can be supported. In some cases the diversion of water from streams in the watershed to other regions outside the watershed or the application of water imported from outside the watershed has changed ecological functions or altered the flow of water through the watershed.

Human activities alter nutrient cycles – Another important natural cycle is the nutrient cycle. As watersheds are developed we tend to increase the amount of water soluble nutrients, often concentrating them in fertilizers or biosolids. These concentrated forms of nutrients can trigger dramatic changes in water bodies, vegetation, and animal communities. Many native plants evolved under fairly low nutrient conditions. Increasing the available nutrients often allows invasive plants to overrun the native vegetation. This can reduce the infiltration capacity of the land and diminish the habitat quality. We often export nutrients from the location that they are generated. In some cases this is through the pollution of water which carries the nutrients to a point where they can support algae or other plant growth that impairs the water. In other cases this is through the transport of waste materials or the application of fertilizers. In any event, the result is an increase in nutrient loads that often diminish the ecological quality in water bodies.

Disrupting habitats and migration corridors – Life cycles and migration patterns of animals is another set of important cycles to consider. Many projects built in the past prior to environmental laws such as CEQA and NEPA have disrupted migration corridors or destroyed or impoverished habitat that is critical for certain life stages of animals. Coastal wetlands that support breeding, nursery and rearing habitat for many ocean species have been particularly hard hit. Dams have blocked access to spawning and rearing habitats for anadromous fish. Riparian forests that support migration of South American birds, and inland wetlands that support the Pacific Flyway species have all been severally impacted.

Fire and water – The management of our forest and brush lands over the past few generations has created a risk of very large, very hot fires that do much more damage to watersheds than fires of historical intensities. The result is that watersheds are not capable of rapidly repairing the damage from these fires. These fires create long periods of erosion and diminish the plant communities that cover the land. They displace animals and limit the subsequent human use of the lands. This results in more water quality problems, more runoff and less infiltration, increased operations and maintenance costs for our reservoirs and canal systems, unstable lands, and large economic losses.

Current watershed management efforts blend community goals and management consistent with the environmental conditions of the watershed. The emphasis on community interests has introduced new methods for managing public discourse within stewardship groups and for collectively identifying principles and projects that are important to the local community. Issues of environmental justice have emerged and been blended into the more traditional project management approaches. Watershed stewardship groups serve as forums for coalescing the needs and capabilities of public and private sector interests, and people who work at the local, regional, state, national, and even international levels.

In addition to the local and regional efforts, a number of statewide initiatives have recently been undertaken to improve our overall ability to practice watershed management. While past bond acts provided specific funding for watershed projects (Propositions 204 and Proposition 13), recent bond acts stress the need for integrated plans and contain incentives to design projects consistent with these plans. This demonstrates just one manner in which watershed planning has evolved in the past decade in California. The bond acts and subsequent legislation associated with Propositions 40 and 50 have established statewide programs for Integrated Watershed Management and Integrated Regional Water Management that support managing resources on a watershed scale and conducting the public outreach, education, and project management required in watershed management efforts. A memorandum of understanding (MOU) exists that directs agencies within the Resources Agency and CalEPA to coordinate their efforts in support of watershed management. One focus of the MOU is to ensure that various state grant programs work in concert to address the most important aspects of watershed management in key watersheds throughout the state. Another focus is to facilitate coordinated work of various state programs involved in watershed management. An 18-month action plan will guide specific project work identified to address these issues.

Recent legislation established the California Bay Delta Authority and, in part, assigned it the responsibility to maintain a watershed program. The initial goals of this program are to

Box 25-3 Some Activities That Might Improve Watershed Management

1. Conduct normal business in a manner consistent with watershed dynamics and characteristics.
2. Design projects with ecological processes in mind and with a goal of making the projects as representative of the local ecology as possible.
3. Establish adaptive management programs that regularly assess the performance and condition of projects to determine if they are satisfying ecological and community needs. Adjust the operations or design the projects as needed.
4. Place projects in the watershed in a way that allows them to reinforce each other and build on the impacts collectively to support the local ecological cycles.
5. Increase the ability for precipitation to infiltrate into the ground, reduce surface runoff to a point where it reflects a natural pattern of runoff.
6. Restore and preserve stream channel morphology to allow access of flood waters to the floodplain and to provide for stable banks and channel form.
7. Maintain and create habitat around stream and river corridors that is compatible with stream and river functions. Provide as much upslope compatibility with these corridors as possible.
8. Rely on native plant communities where feasible in landscaping, agriculture, forestry, and restoration work.
9. Incorporate nutrient cycles that rely on the local watershed to supply and receive nutrients for important processes in the watershed.
10. Preserve features that support migration corridors or critical life stage habitats.
11. Sponsor and participate in watershed stewardship groups.

Note: All activities may not be applicable to all watersheds.

build local capacity to engage in watershed management, to promote the development of watershed assessments and plans, and to support specific projects designed to improve local management of watershed resources. The goals for the CALFED Watershed Program are to provide assistance, both financial and technical, for watershed activities that help achieve the mission and objectives of the CALFED, and to promote collaboration and integration among existing and future local watershed programs. The CALFED Watershed Program, with assistance from various State agencies, manages a grant program to achieve these goals.

The combination of a rapidly increasing number of local watershed management efforts and improved grant funding has broadened the interest in watershed management so that local public agencies that once relied on narrow program funding for support are engaging in watershed management to address their needs.

Benefits of Watershed Management

Improve Water Supply Reliability and Management Flexibility

Watershed scale assessments, restorations, and projects have illustrated the potential to improve the ability to capture, store, and use water. For example, in the Feather River Watershed, meadow restoration has improved the ability of the watershed to capture snowmelt and spring runoff, which in turn has lowered flood potentials and increased summer base flows in streams. This provides improved ability to capture water in summer for export in the State Water Project. It also potentially reduces operations and maintenance costs of projects in the watershed and alleviates flood damage. These improvements are consistent with the natural hydrology of the basin and serve to restore many ecological functions associated meadows and streams.

Preserving Ecological Functions and Processes

Watershed management helps preserve ecological functions and processes by helping us consider natural cycles (hydrologic, nutrient, and life cycles) when designing projects. For example elevated stream temperatures are often identified as a problem. Promoting groundwater accretion to streams and improving riparian cover often cools stream temperatures. Designing projects to allow more water to soak into the ground, less water to sheet off as runoff, protecting the soil surface from erosion by planting native plants, and stabilizing stream channels with vegetated buffers brings the stream more in line with the natural watershed cycles and sustains important ecological processes.

Reducing Flooding Potential

Watershed management helps reduce flooding along streams draining the watershed. Preserving a more natural vegetated channel configuration and overflow areas helps slow and lower peak flows.

Improving Water Quality

Watershed management helps improve water quality by maintaining natural vegetated stream buffers that filter pollutants and nutrients.

Connecting to Other Things in the Watershed

Identifying important aspects of the watershed condition and trend can help guide activities to achieve a sustainable watershed that is connected with the working ecology. Watershed management helps identify how a new project has influences beyond the immediate project area and highlights opportunities for further watershed enhancements. In addition, it allows for easier identification of risks to sustaining the essential characteristics of the watershed. Understanding these influences provides opportunities to conduct business in a manner that is supportive of watershed dynamics.

Enduring Value

Watershed management provides the ability to generate enduring value from the integration of ecology and community interests. The melding of interests reduces or eliminates competition for resources, provides satisfying outcomes to many people, and yields cost effective solutions. Participation on a watershed management or stewardship group can give people a safe and open forum to express their ideas. Projects that are designed with an ecological scale in mind have a lower risk of being undermined by natural events than projects designed only looking at the site scale. Projects incorporating ecological conditions also preserve and enhance ecological conditions for future generations thereby contributing to fulfilling Public Trust responsibilities (see Volume 1, Chapters 2 and 3).

Costs Associated with Watershed Management

Costs associated with watershed management depend on site specific conditions such as the size of the watershed and actions to be implemented. In some cases, the actions will include physical projects to alter watershed conditions and in other cases the actions will be limited to programs that simply influence watershed use.

Table 25-1 Preliminary estimates of watershed management costs

Period (years)	Assessment-Planning [1] ($ million)	Public Process [2] ($ million)	Projects [3] ($ million)	Total for period
2004-2009	$10-37.5	$8-16	$14-80	$160 - 667
2010-2015	$10-30	$8-16	$14-88	$160 - 804
2016-2030	$10-25	$8-16	$14-100	$160 - 2,115
Total				$480 - 3,586

[1] CALFED service estimated as 40% of statewide need. Therefore, statewide Assessment and Planning = 2.5 x CALFED values from Draft CALFED Finance Plan.
[2] The service area for Public Process estimated as 25% of statewide need. Therefore, statewide Public Process = 4 x CALFED values.
[3] For Projects, CALFED service area is estimated to be 25% of the statewide need. Therefore, statewide Public Process = 4 x CALFED values.

Currently, costs are incurred for measuring various features in the environment, planning projects, and building the projects. Incorporating ecological functions into projects does not necessarily add costs. For example, some nurseries in Southern California have found that by growing plants in the peripheral drainage ditches of their properties they are able to reduce nutrient discharges and wastewater while growing a saleable crop. In agricultural settings tailwater ponds and vegetated canal systems have replaced disking and spraying of field edges and canal banks. Providing stream systems access to their floodplains has reduced the potential damage from levee failures and lowered maintenance costs.

Some activities that may result in new costs (rather than simply redirecting existing expenditures) include watershed monitoring and assessment, support for watershed coordinators, increased restoration work, preservation of certain land use capabilities through easements or other forms of fee-titled adjustments, and extended periods of time in planning and design to accommodate watershed ecology. Actual costs for these activities are difficult to estimate and may largely be offset by savings in other aspects of watershed management, such as water supply reliability, flood damage reduction, reductions in threatened and endangered species listings.

DWR estimates about $0.5 billion to $3.6 billion could be spent on watershed management in California to year 2030. The estimates are based on scaling CALFED watershed management estimates up for statewide coverage. Table 25-1 shows these estimates by time period.

Major Issues Facing Additional Implementation of Watershed Management

Lack of Appreciation for the Role of Watersheds

In general the role of watersheds in sustaining our economies, businesses and communities is not fully appreciated. Providing for a greater understanding of watershed dynamics and how our communities and economies rely on their local watersheds will require working within schools, encouraging the business community to become involved in watershed management, and providing opportunities and incentives to the larger community to be involved in watershed management.

Fairness, Inclusion and Decision Making

Because many watershed projects are collaborative, projects often require coalitions to successfully implement them. However, the governance of these groups is not standard. They range from ad-hoc groups, to formal delegations of authority. Discussions often take significant time. All participants do not have the same ability to stay involved so issues of fairness and inclusiveness can arise.

Science and Understanding

There is not a readily available source for finding key ecological information that can be incorporated into projects. Scientific assessments seek to provide a good technical description of watershed conditions, but cannot be definitive. State agencies can help in describing important ecological processes and functions throughout the state. As watershed assessment matures, a better understanding will likely emerge and more localized information will become available.

Adaptive Management

Adaptive management requires the regular measurement of various watershed projects and characteristics. It also requires assessing these measurements and designing and implementing responses to findings that suggest the watershed is not being managed well. In relatively few cases have watershed stewards established and maintained the needed monitoring and assessment activities. Efforts to respond to periodic assessments often are not pursued from a watershed scale, instead being limited to project specific issues.

Recommendations to Help Promote Additional Watershed Management

1. State, federal, local, public and private interests should develop new means to collectively reinvest in sustaining watershed ecological and social health. Particular attention should be paid to developing means for urban areas to reinvest in sustaining the quality of rural watersheds that provide water supplies for the urban areas.
2. Watershed management assessments and plans must include quantitative efforts to improve water supply flexibility and the timing and amount of water available for diversion without significantly impacting watershed condition or trend.
3. State grant-distribution should be based on meeting specific criteria that support watershed assessments, planning, public involvement, and integrated project design and operations that result in multiple benefits.
4. Education efforts to inform the general public and specific constituencies about the role watersheds play in sustaining their communities should be undertaken at all levels of watershed management. Specific efforts to link to schools including K-12, community colleges, and universities should be undertaken by State grants and agency programs working on watershed scales.
5. State agencies should pursue the goals and initiatives in the California Agency Watershed Management Strategic Plan (draft August 18, 2003).
6. State and local agencies should improve and expand their expertise in broad-based public decision making processes and participate in watershed stewardship groups. Attention should be paid to improving the use of stewardship group processes to help in achieving agency program responsibilities.
7. Watershed management efforts should design and implement, supported with State, federal, and local resources, adaptive management programs that include monitoring, assessment, and processes for defining project redesign and re-operations that bring management efforts more in line with local ecological functions. Adaptive management support should include funding for citizen monitoring of watershed conditions including water quality monitoring.
8. Fish and wildlife resource managers should be encouraged to develop management plans on an ecosystem or watershed basis as opposed to what is often species-specific.
9. Environmental, social, and economic benefits of public and private managed wetlands should be integrated into watershed management efforts including planning, education, water quality, flood control, and groundwater recharge.